Arctic Research Program's Observations

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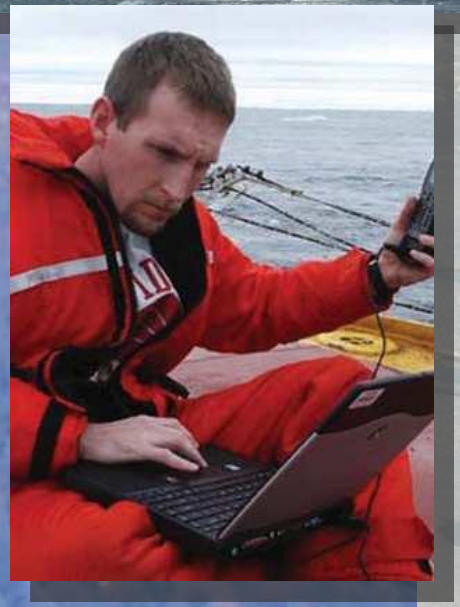
June 22, 2011

NOAA'S ARCTIC OBSERVING GOALS

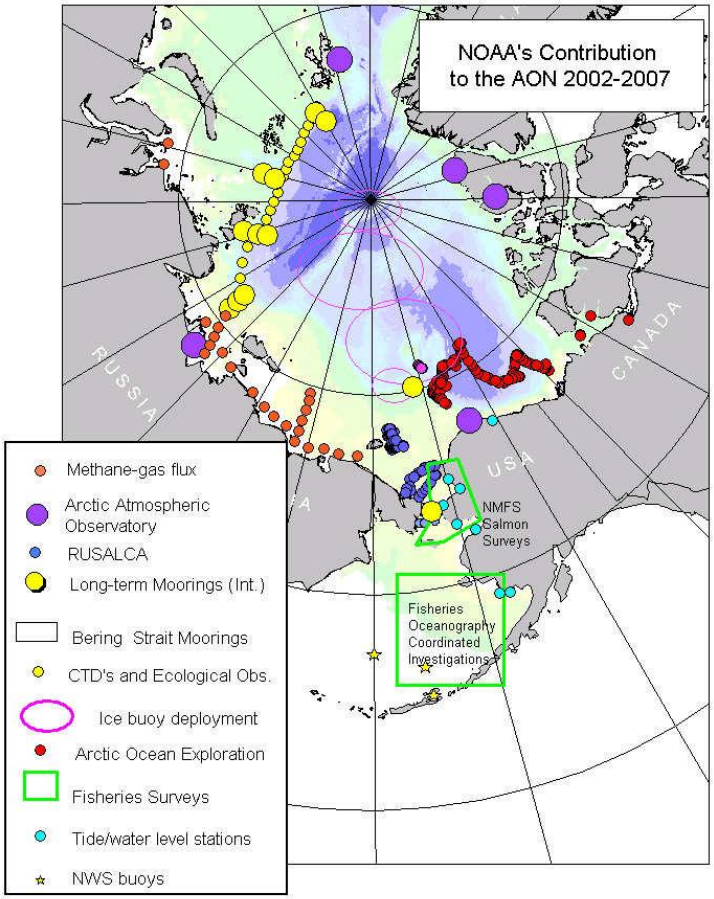
Suggested Arctic Ocean Observing System: as proposed by SEARCH (The Study of Environmental Arctic Change), 2005 Implementation Workshop



IPY Legacy Project

Arctic Observing Network: Supported by the ARP 2002-2007

- Sea Ice
- Atmospheric Observatories
- Ocean – ecosystem Observations and modeling in Pacific Arctic Sector



Sea Ice Observations

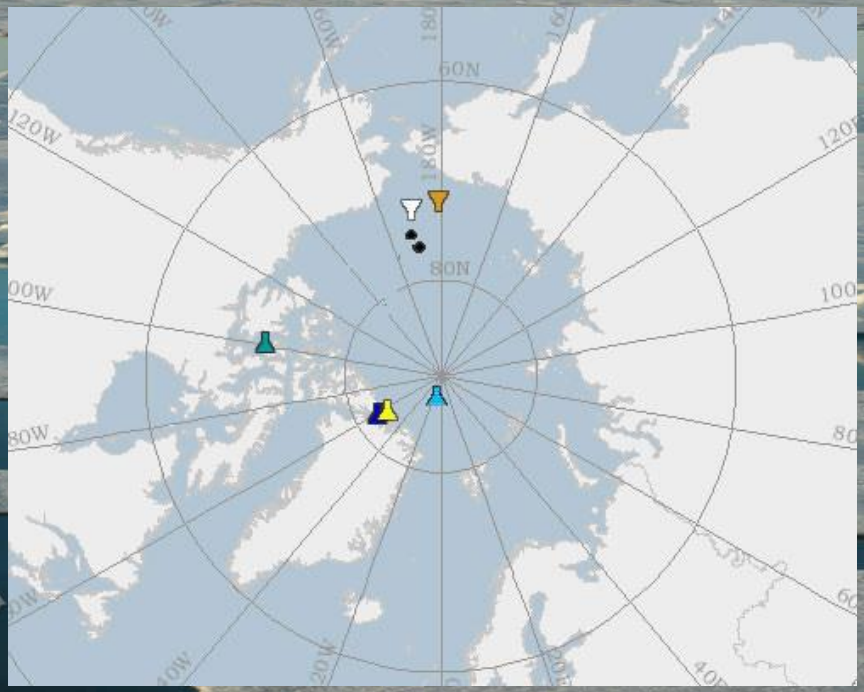
Ice Mass Balance Buoys (Richter-Menge, Perovich - CRREL)

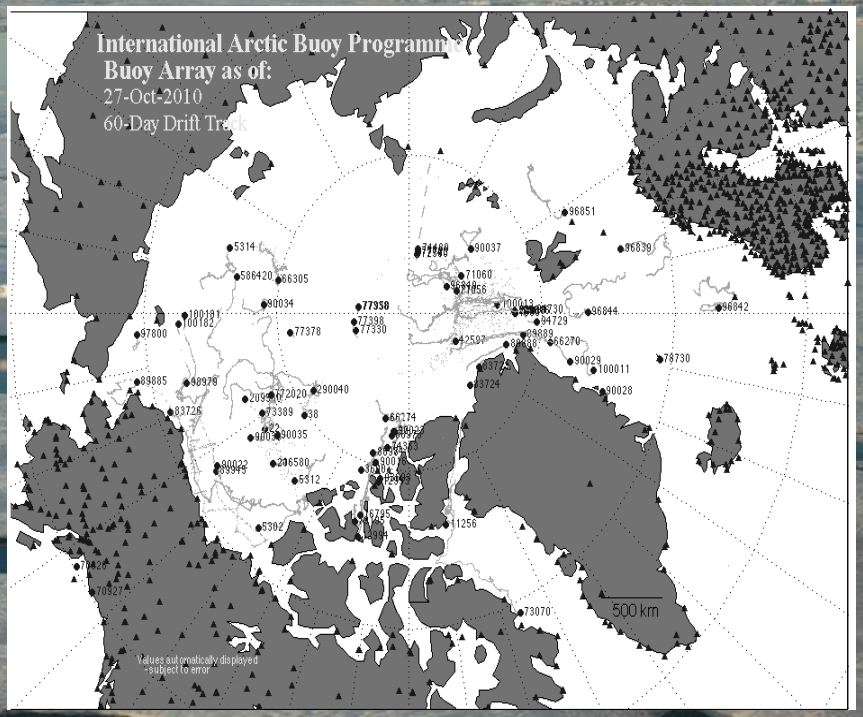
Research – measure snow cover and ice growth and melt from above and below

International Arctic Buoy Program (Rigor – UW)

Operational Through JCOMM

T, P and location in real-time to HMC



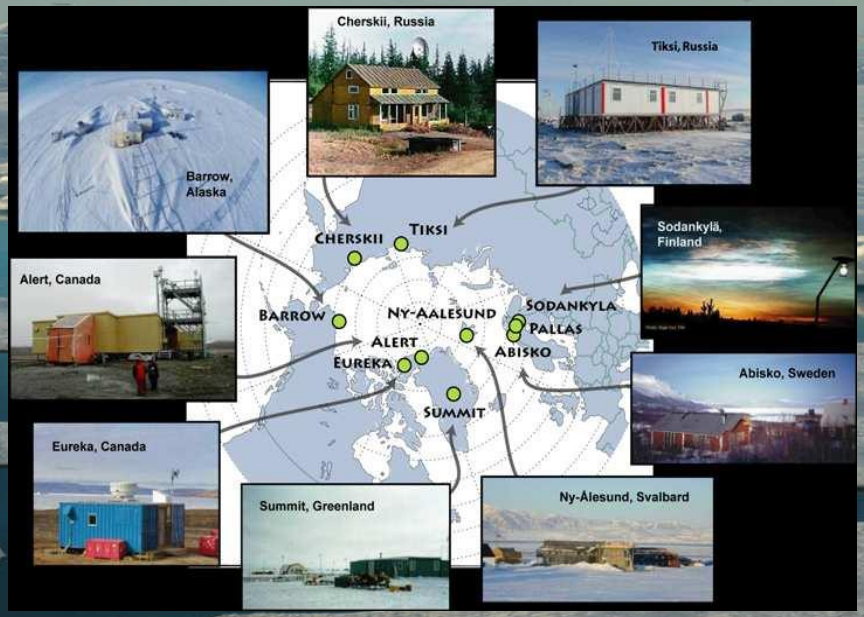


Atmospheric Observatories

Circum-Arctic network (Uttal – ESRL/PSD)

CPO/ARP focuses on Alert/Eureka and Tiksi

Co-funding by NSF



Focus on Clouds, Radiation, Aerosols

- How do clouds, aerosols and atmospheric chemistry interact to force the Pan-Arctic surface energy balances and albedo-temperature feedbacks?
- What is the relative role of tropospheric dynamics and stratospheric linkages in controlling the Arctic surface variability?
- What portion of the recent changes in the Arctic weather and climate can be attributed to increases in anthropogenic sources?
- How does the Arctic atmosphere interact with the rest of the Arctic (marine, cryospheric and terrestrial) system?

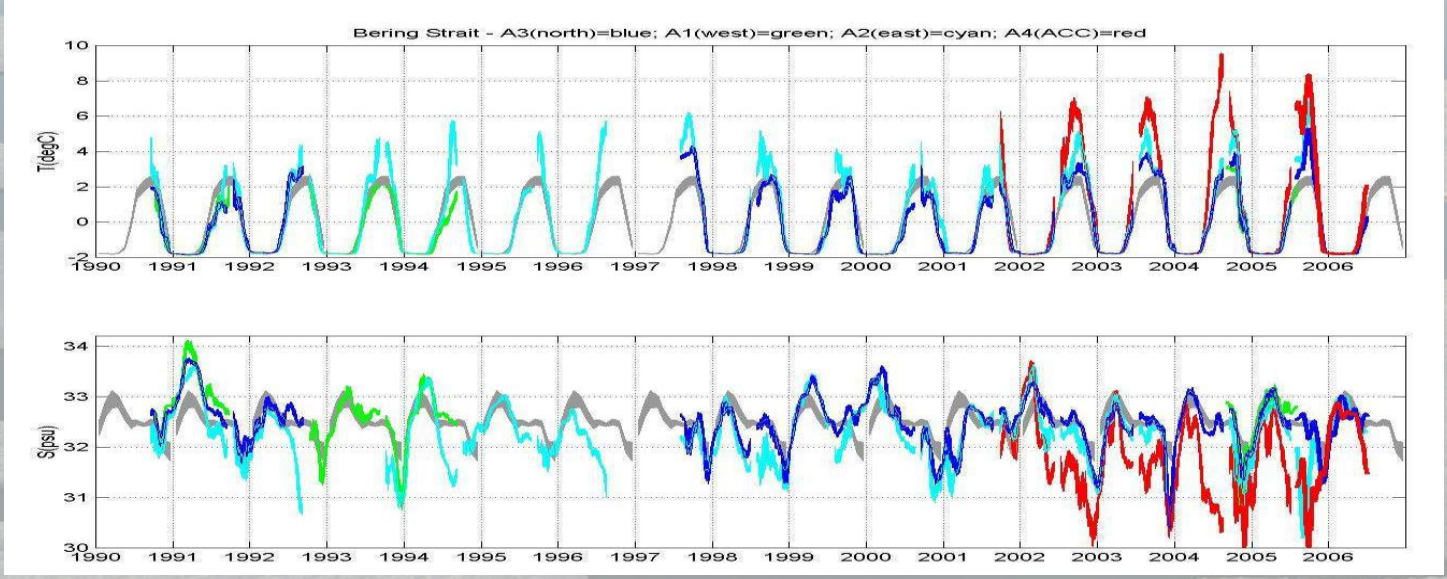
TIKSI, Existing Components

- NSF infrastructure contributions
- NOAA project coordination and long-term design
- NSF funding of science projects
- Government of Sakha road and power improvements
- Roshydromet weather station upgrades – communications and weather station measurement systems

- NOAA observation programs
- Roshydromet observation programs
- NASA observation programs
- FMI observation programs

Ocean Observations in Pacific Arctic

- Bilateral project with Russia – Russian-American Long-term Census of the Arctic (RUSALCA = mermaid in Russian)
- Quantify physical variability and change
- Examine ecosystem response
- Develop model/data assimilation to aid analysis



RUSALCA

Bering Strait Moorings (Woodgate – UW, Weingartner – UAF, others

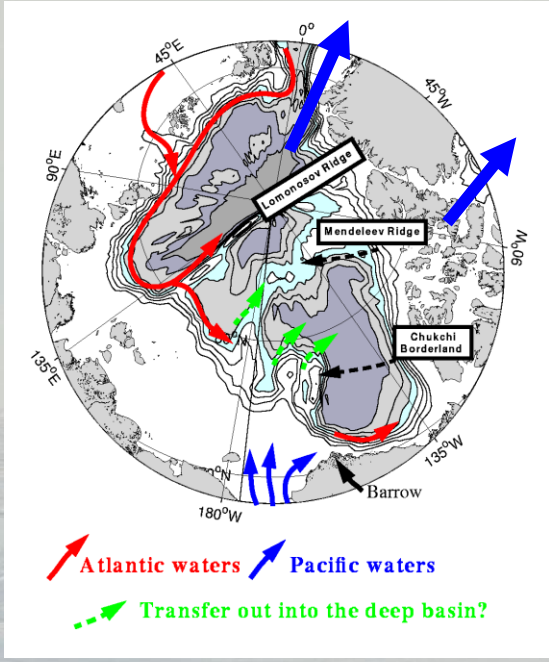
- Quantify flux of mass, heat, salt, nutrients
- Permanent moorings (8), with annual recovery and redeployment
- No real-time data due to ice
- Bottom pressure recorders, acoustic sensors on some moorings
- pCO_2 sensors coming this year
- Co-funding by NSF, Russian Academy of Sciences

Chukchi Sea physics and biology (UAF, WHOI, others)

- Anticipated (now demonstrated) area of rapid sea ice loss
- Investigate water mass and circulation changes
- Link with ecosystem observations at several trophic levels
- ~ every 4 year frequency of sampling – 2012 will be 3rd

Global role of Bering Strait

A Freshwater source for the Atlantic Ocean

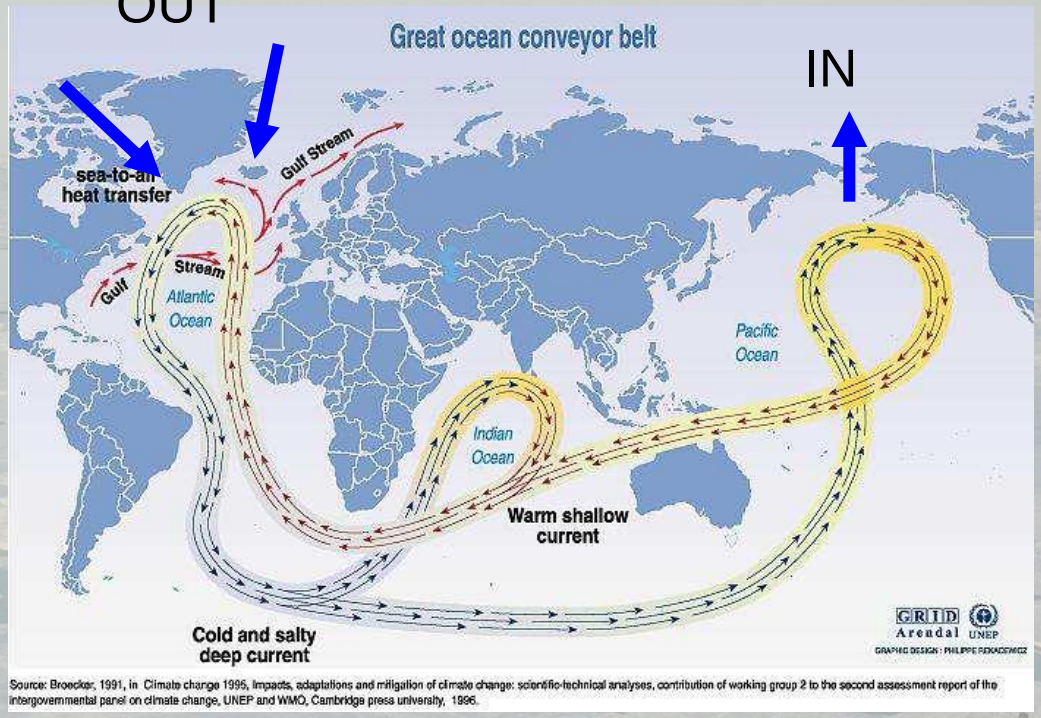


Pacific waters exit the Arctic through the Fram Strait and through the Canadian Archipelago

(Jones et al, 2003)

OUT

IN

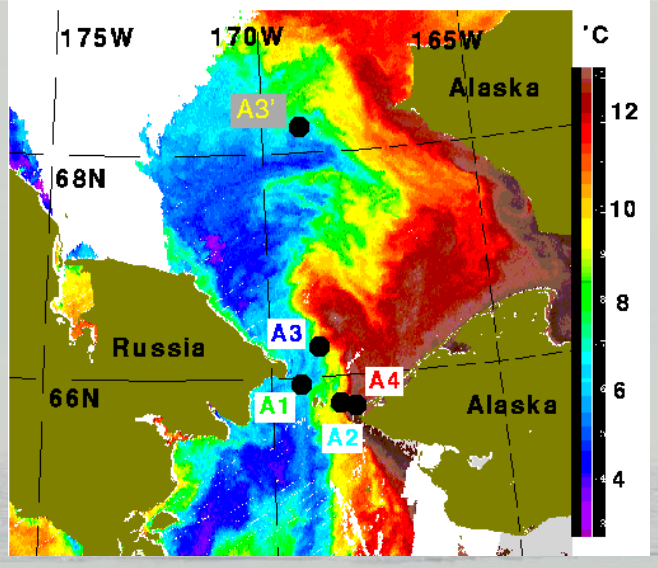


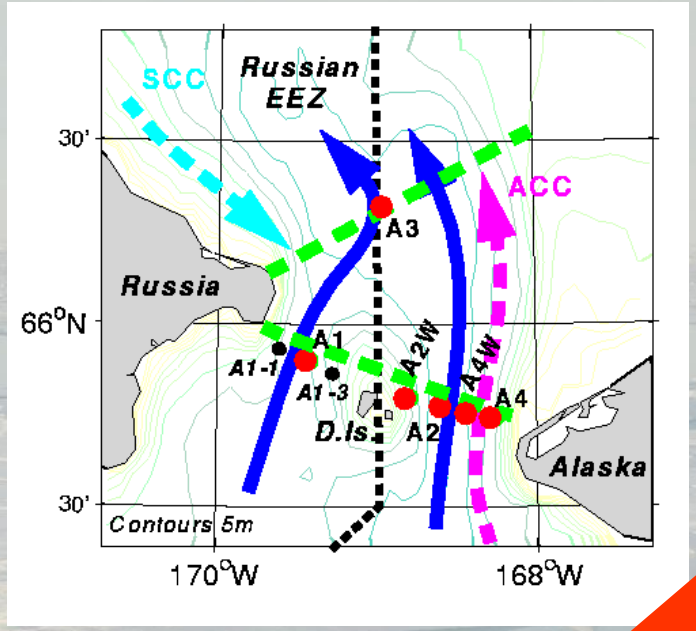
Broecker, 1991

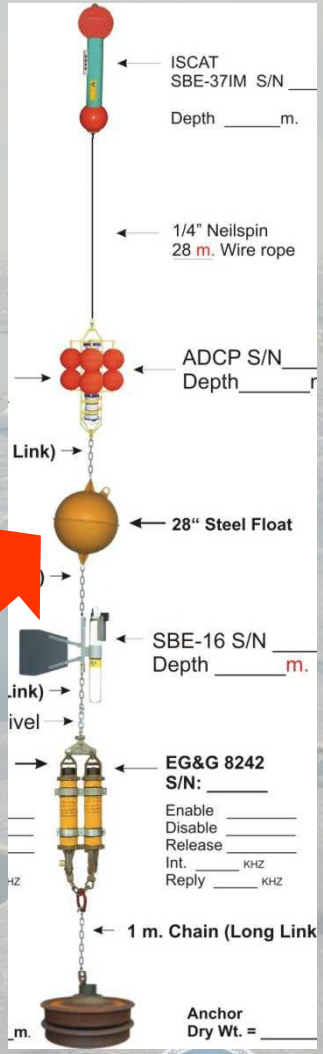
Freshwater inhibits deep convection, slowing the Atlantic Ocean overturning circulation (see Wadley & Bigg, 2002, for a discussion)

Models suggest the Bering Strait throughflow also influences the deep western boundary currents & the Gulf stream separation *(Huang & Schmidt, 1993)*

Bering Strait Moorings







Your instrument here!!!!

Since 1990

1-4 near–bottom moorings

Since 2007

(International Polar Year)

8 moorings with upper and lower sensors

Now also with

- Whale Recorders – Kate Stafford and Carter Esch
- pH and pCO2 sensors – coming 2011

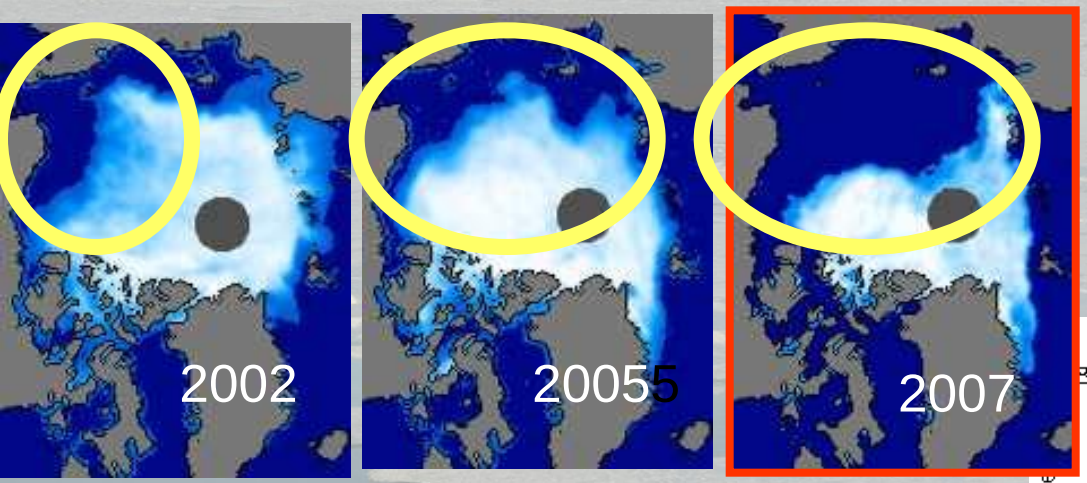
Annual CTD sections

Woodgate 2010

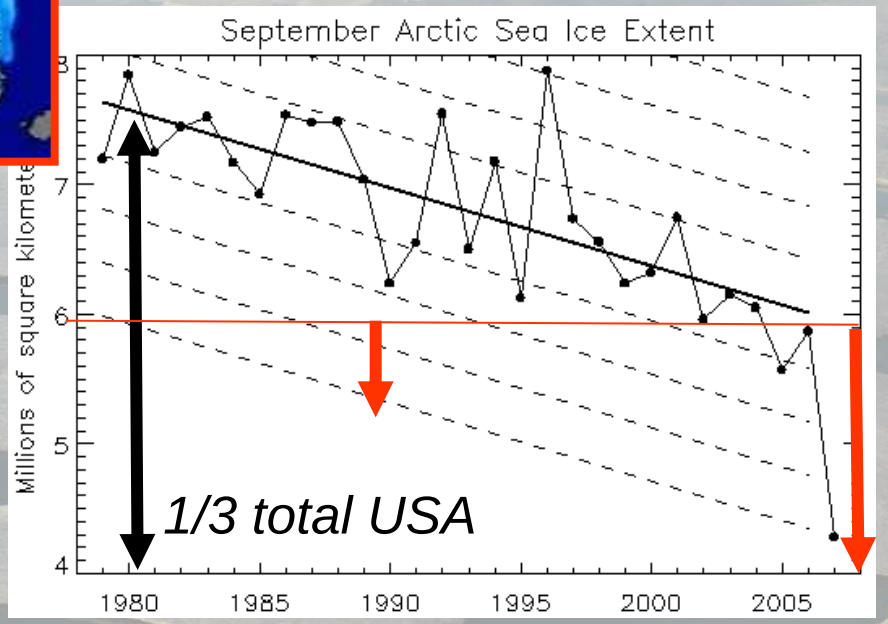
Meltback in area of Pacific Water influence

Roles of Bering Strait in sea-ice retreat:
- triggers the melt (then ice-albedo feedback)
- gives freshwater stratification to keep solar heat shallow
- winter source of subsurface heat

Bering Strait
~ 2-6 x 10^{20} J/Y



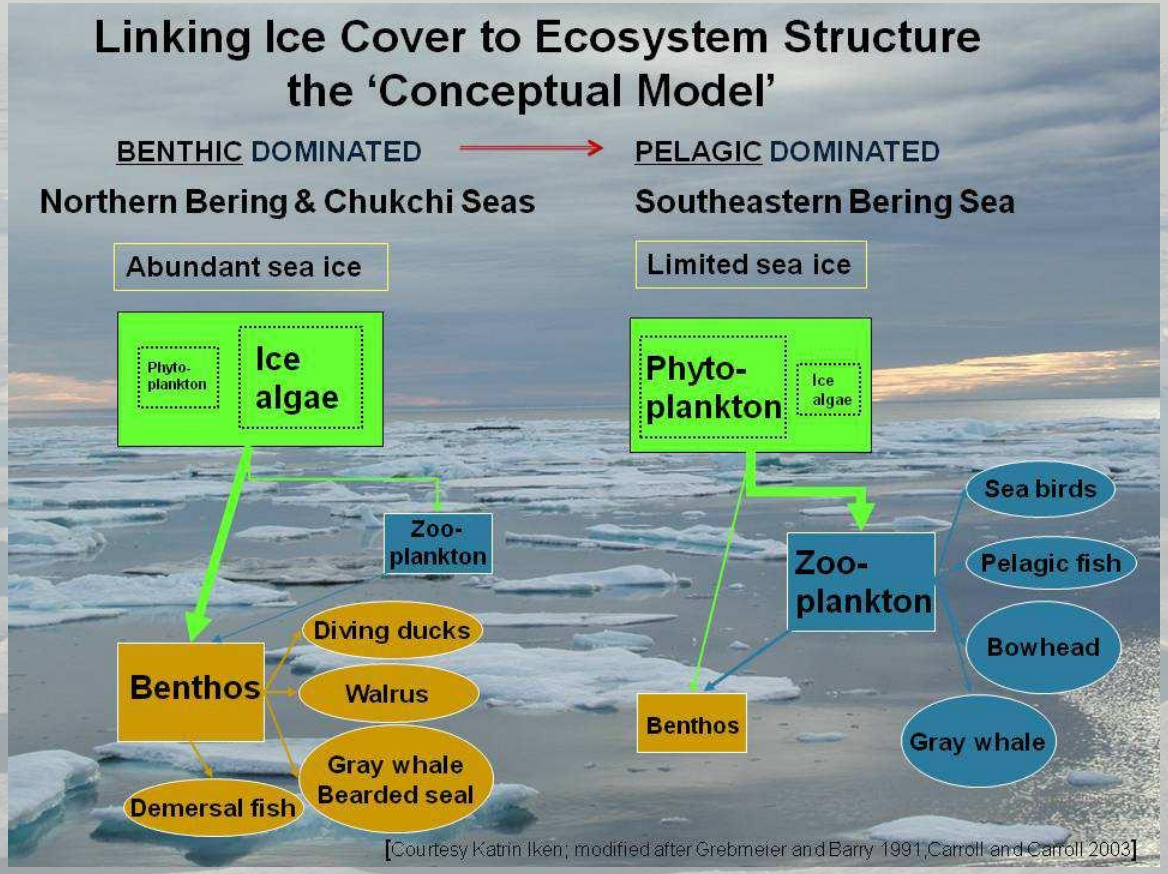
could melt
0.6- 2 million square km
of 1m thick ice



Minimum (Sept) Sea-ice extent

Stern, UW, Data NASA

Loss of Sea Ice and Ecosystem Changes (RUSALCA)



Present Day

Future?

TRACKING ECOSYSTEM CHANGES IN THE ARCTIC

RUSALCA 2009
Chukchi Cap →

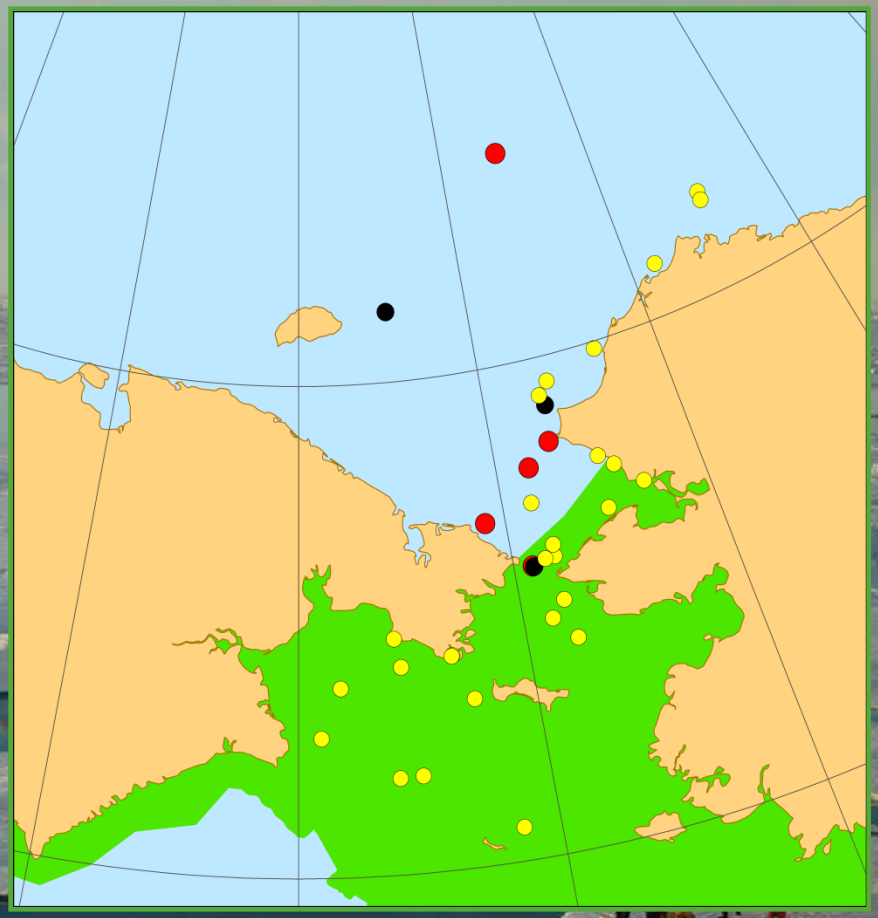
Lycodes adolfi
Adolf's Eelpout

Nielsen & Fosså 1993

Found north of Spitsbergen on east side of Yermak Plateau in 2007–2009 (Byrkjedal In press), indicating distribution probably extends eastward along the upper slope of Nansen Basin (and thence to the Pacific-Arctic, where we caught it)

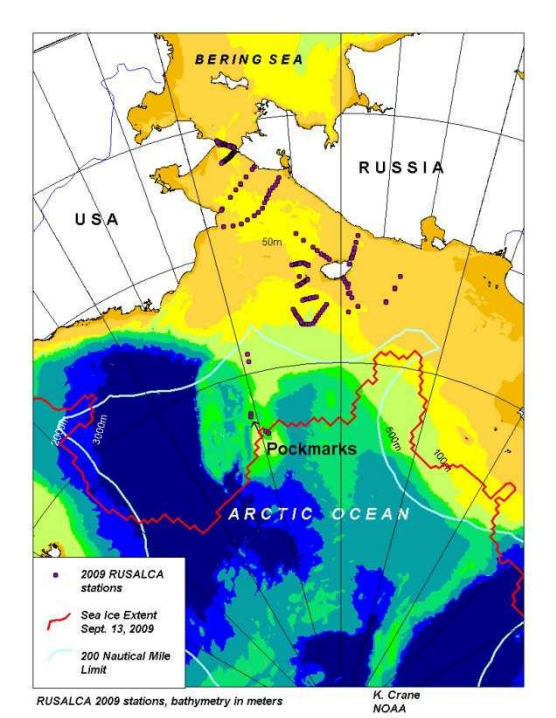
RUSALCA

Walleye Pollock found Further North, 2004-2009



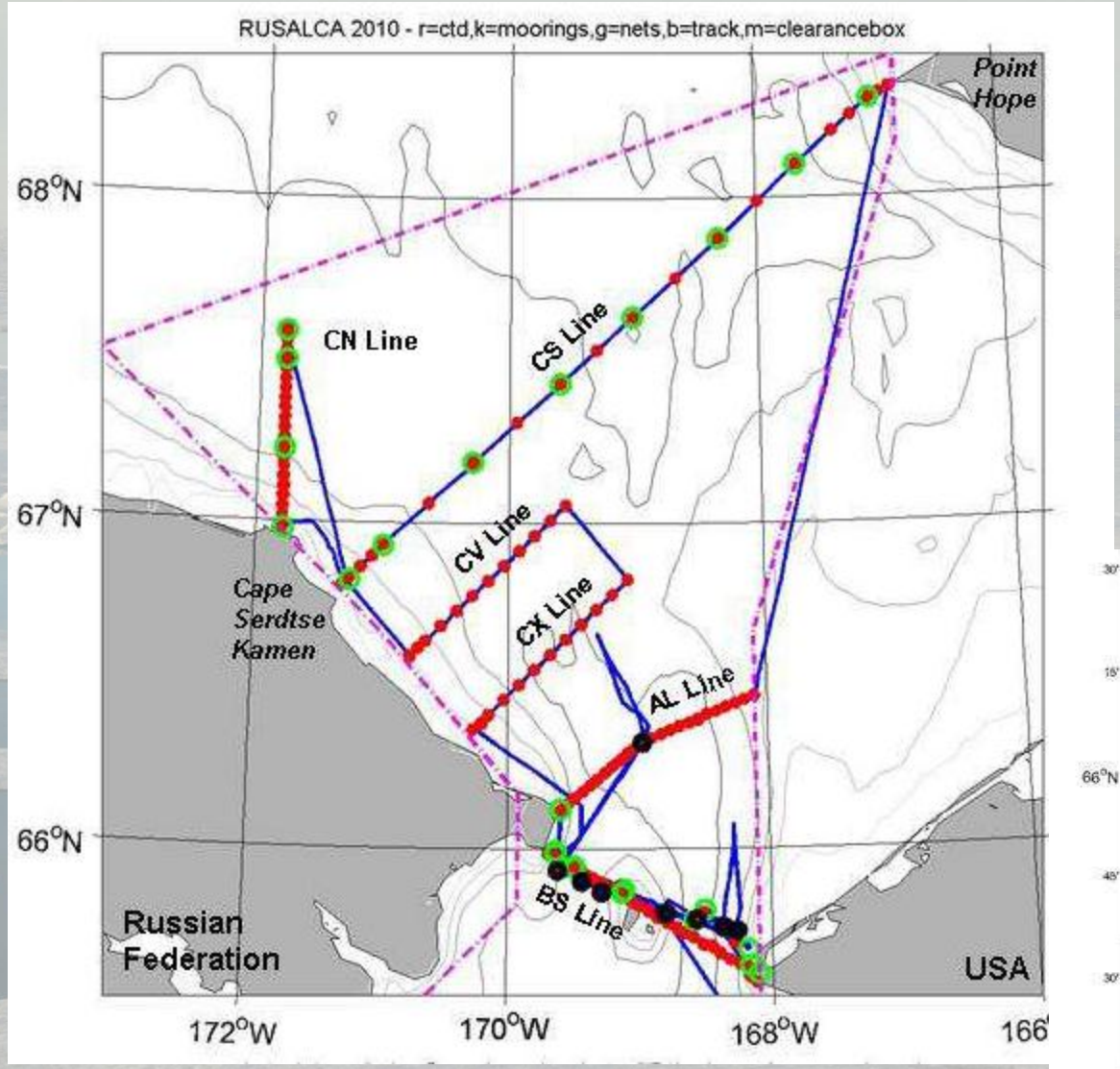
Walleye Pollock
Gaddus chalcogramma

RUSALCA 2004-2010

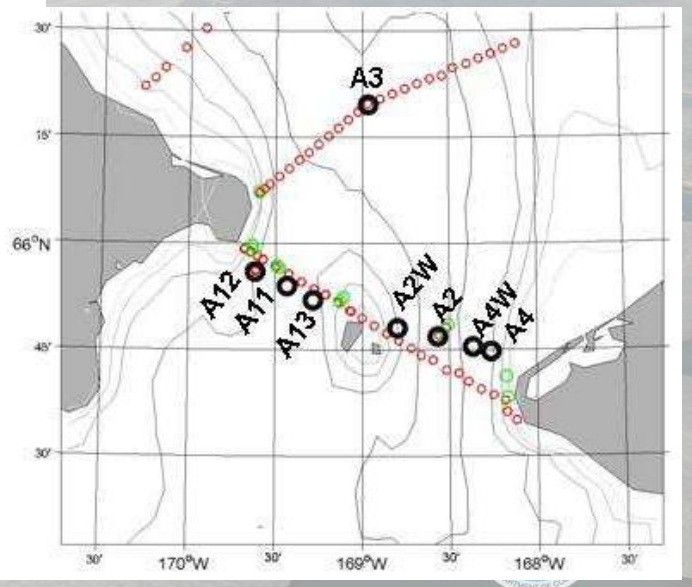


- Took the furthest north trawl in the Pacific Arctic
- More than 300 km north of the ice line in 2004
- Moved to the East Siberian Sea.

RUSALCA 2010



Mauve = clearance box
Blue = ship track
Black dots = moorings
Red dots = CTDS
Green dots = nets
+ 4 Primary productivity stations



Arctic Change Detection (Overland, Wang, Wood – PMEL)

- Data rescue and retrospective analysis
  - First circum-Arctic analysis of data from 1882 IPY
- Evaluation of IPCC models to assess validity in the Arctic region
  - Compare model outputs to past century observations to determine more realistic future projections
- New projections of rate of sea ice loss
  - Sea-ice-free summers by mid-century
- Linkage from sea ice loss to atmospheric circulation
  - Cold east coast winters associated with Arctic sea ice loss?

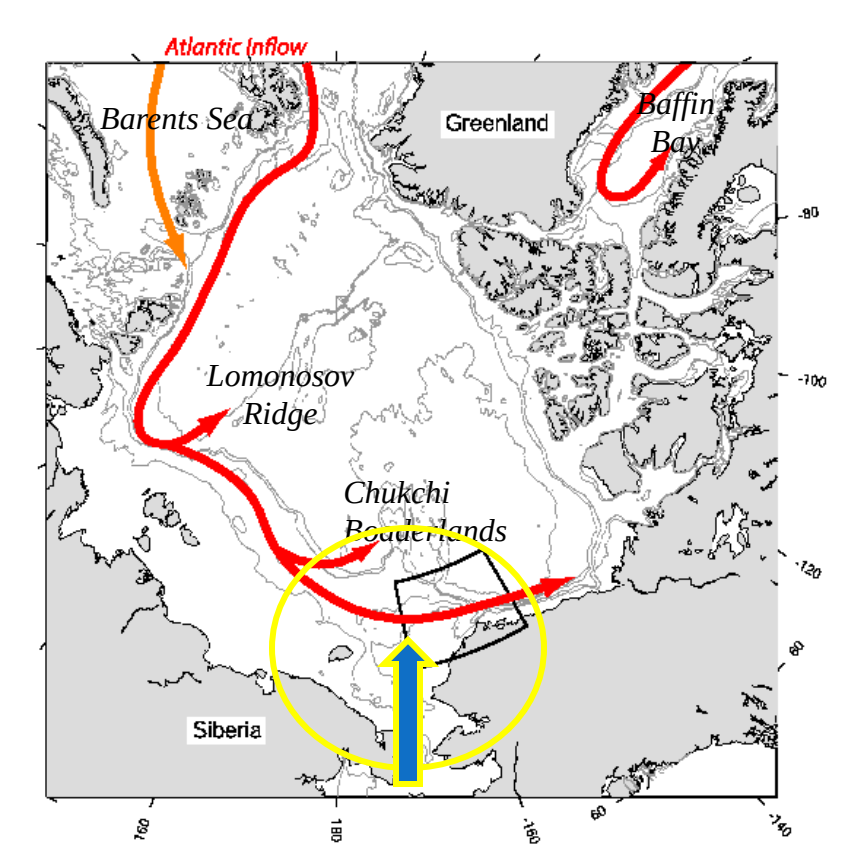
ARP Builds and Provides Guidance to International Partnerships

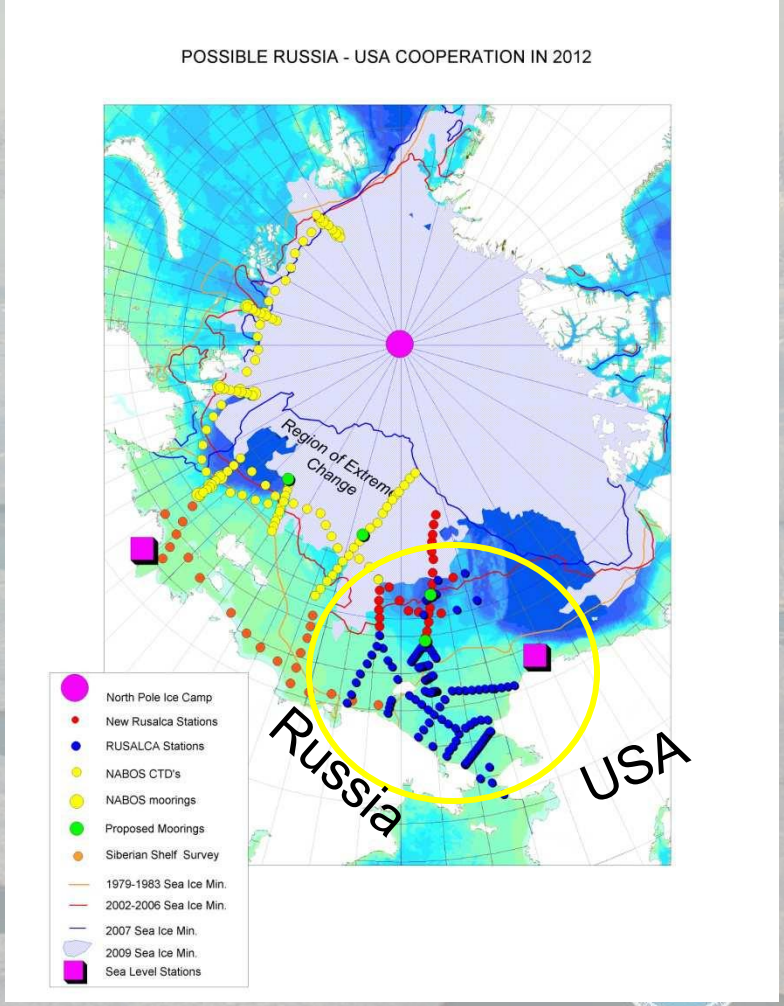
Five-year Strategy of the ARP

- Engage with the Russian Federation to carry out bilateral observational programs in the Bering Strait, the Arctic Ocean with the programs: RUSALCA, TIKSI Observatory, East Siberian Sea Methane
- Provide leadership and resources to support the ARCTIC COUNCIL (AMAP, CAFF) and IASC.
- Build International Collaboration in the Pacific Arctic via the PACIFIC ARCTIC GROUP (Japan, China, Korea, Russia, USA, Canada)
- Support implementation of effective SAON process and the CMBP-Marine Plan

Launch of rosette during 2009 RUSALCA expedition

FUTURE ARCTIC RESEARCH GOALS: Role of Atlantic Water and Pacific Water on the Transport of Heat and Biota into the Pacific Arctic (RUSALCA Region)





Future RUSALCA observing 2012-2020

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